<u>MEMORANDUM</u>:

DATE: February 5, 1999

SUBJECT: Refinements to the EPA Inventory Database for Stationary Combustion Turbines

FROM: Keri Leach
            Alpha-Gamma Technologies, Inc.

TO: Sims Roy
            EPA OAQPS ESD Combustion Group

The purpose of this memorandum is to document the activities conducted to refine the EPA Inventory Database for Stationary Combustion Turbines. This database provides population information on known operating units in the United States. It will be used to support rulemaking decisions for the stationary combustion turbines NESHAP and NSPS efforts.

<u>Data Gathering Efforts</u>

The data in the inventory database is based on point source information from available databases, such as AIRS, OTAG, and state and local agencies' databases. This information includes references to location, unit size, application, and other operating parameters for each unit.

<u>Database Development and Format</u>

The first version of the EPA Inventory Database was released in 1997. Subsequent versions have been released reflecting additional or updated data. The most recent release of the database is version 4, released in November, 1998.

The format of the database is a series of tables. There are two types of tables: data tables and lookup tables. The latter contain descriptions of codes used in the fields in the data tables. Each data table contains information on a specific aspect of a combustion unit; for example, the table "DATA: General Facility - Turbine" contains general information on the facility at which the turbine is located. A listing of the tables contained in version 4 is in Appendix A.

The records in the data tables can be linked from table to table using the ICCR Facility ID, Combustor ID, and Segment Number fields. The ICCR Facility ID identifies the facility at which the unit is operating. The Combustor ID is a unique identifier for each unit at a given facility. The purpose of the Segment Number is to provide a means to store information on operational capabilities of a given unit. Units are typically assigned segment numbers to indicate the capacity of the unit to fire more than one fuel type. Tables in the database can be linked using these fields.

Version 4 of the database contains information on approximately 4,800 units. It is estimated that the current turbine population in the United States is approximately 8,000 turbines. Therefore, the inventory database contains data on approximately 60% of the installed turbines in the United States. It is expected that the database has better coverage of larger turbines.

Within the database, varying degrees of information are available for different turbine parameters. For example, there is information on the fuel type for virtually all turbines in the inventory database. However, there are limited make and model data given for individual units; only 13% of the units are populated with both make and model information while 5% are populated with information on turbine make only. There is also limited information on the capacity of the units in the database; size information is provided for approximately 57% of the turbines in the database.

Refinements to the Database

Database enhancement activities were undertaken in order to maximize the amount of useful information that could be gleaned from the database. Descriptive information from selected fields within the database was extracted in order to enhance the usefulness of the database. The attached database, "Ctrefine.mdb", is in Access '97 and contains the tables that are the main refinements to the database. The first is a table called "CT SSLOF - version 4." SSLOF is an acronym for "Shortened Short List of Fields," referring to the "short list of fields" created by the Combustion Turbine Work Group (CTWG) of the Industrial Combustion Coordinated Rulemaking (ICCR). The EPA Inventory Database has over 100 fields. Therefore, the CTWG established a "short list" of fields in the EPA Inventory Database that contain the most critical information for analyzing the database population. SSLOF is an abbreviated version of this list; it contains fields from version 4 of the EPA Inventory Database for Stationary Combustion Turbines (referred to as "primary source" fields), as well as additional fields that have been created to enhance the usefulness of the database.

A list of the fields in SSLOF that were extracted from primary source data tables included in version 4 of the EPA Inventory Database is included as Appendix B. Fields that were created as a refinement to the primary source data tables are presented in Appendix C, Table 1. A source code field accompanies each field that was created to denote the origin of the data in the field. An explanation of each of the source codes is included in Table 2 of Appendix C. When information for a particular field could be extracted from more than one primary source field, an order of prioritization was followed for cases of conflicing data. This order is indicated in each of the definitions for the source codes in Appendix C, Table 1, when applicable. For example, if fuel type was different in the "Fuel type" and "Combustor Description" primary source fields, the fuel type listed in SSLOF was taken from the "Fuel type" field.

Information was extracted from fields in the primary source data tables by utilizing queries and manual searches. Turbine make and model, capacity, and the type of fuel fired are among the descriptive information that was searched for in the primary source fields. The number of turbines associated with a particular record was also searched for; it was assumed to be one unless indicated otherwise in a primary source field. Other potentially useful information describing the turbine, such as

emergency or cogeneration operation, was noted in the "Other info" field when encountered in a primary field. All searches were conducted by looking for key words and combinations of letters in each of the relevant primary source fields. Examples of the key words and combinations used for the fuel type search are provided as an example in Appendix D. Specific examples of conclusions drawn about turbine parameters based on key words and phrases in primary source fields are provided in Appendix E.

A main refinement activity undertaken to improve the usefulness of the database was the conversion of all reported capacities into one standard unit, megawatts (MW). Capacity units provided in the database include MMBtu/hr, horsepower, lbs/hr, million cubic feet burned/hour, and others. Whenever possible, the units provided were converted to MW, creating a consistent basis for capacity comparison among turbines in the database. This refinement enables the database to be used to conduct analyses based on or including turbine capacity. The converted capacities for each unit are stored in the "Cap MW" field in the SSLOF table. In this way, the refined data is easily usable without the primary source table being altered (in this case, the "DATA: Inventory - Turbine" table).

The table "Non-turbines identified in version 4 from the CDF" is a table listing units that may not be turbines based on the information provided in the "Combustor Description" field of the primary source table "DATA: Inventory - Turbine." These units have been left out of the SSLOF table. Queries and manual searches were utilized to search for key words indicating combustion units other than turbines. Examples of these key words are listed in Appendix D. Specific examples of units which were concluded to be non-turbines based on key word and phrase identifiers in primary source fields in the database are provided in Appendix E.

How to Use the Database Refinement Tables

The refinement tables in "Ctrefine.mdb" can be used in combination with version 4 of the EPA Inventory Database for Stationary Combustion Turbines. Every record may be linked to the primary source tables in version 4 by linking the ICCR Facility ID, Combustor ID, and Segment Number fields between the tables being linked. In this way, primary source fields that are not in the SSLOF table can be related to the data already assembled, and units that may not be turbines can be excluded from data analyses. For instance, the SSLOF table can be linked to the General Facility table (linking by ICCR Facility ID) to pull in fields describing the facility. Query criteria can then be used to analyze trends in turbine parameters by location, for example.

It is important to note when joining the SSLOF table to primary source tables that while the ICCR Facility ID, Combustor ID, and Segment Number fields constitute the most complete and unique identification for a specific unit in the database, all three fields are not present in each primary source table. The extent to which they are in the primary source tables depends on the type of information in each table. For instance, the table "DATA: General Facility - Turbine" includes the ICCR Facility ID field only, because the data in this table is provided on a facility basis. The table "DATA: Inventory - Turbine" provides data on a combustion unit level; therefore, it contains both the ICCR Facility ID and

Combustor ID fields. The table "DATA: Fuel - Turbine" further breaks down the combustion unit into specific data reported on a segment level; therefore, it has all three identifier fields. Whichever fields among the three identifiers (ICCR Facility ID, Combustor ID, and Segment Number) are common between SSLOF and the primary source table to which it is being joined should be linked.

The advantage of using the SSLOF table for analysis of the EPA Inventory Database for Stationary Combustion Turbines is that it brings together the most important fields from primary source tables in version 4 of the database and extracted information from these fields. The extracted information would otherwise remain embedded in descriptive fields and would be less accessible for analysis of the database population. Another advantage to using the SSLOF table is that turbine capacities are reported using a consistent unit, MW. This feature is unique to the SSLOF table and makes the capacity information reported in the primary source table of the database more usable. In addition, units that were determined to be non-turbines are not included in the SSLOF table. Therefore, when the SSLOF table is linked to primary source data tables, units that were determined to be non-turbines are automatically excluded from consideration.

The SSLOF table is useful in that it contains refinements already made to the database, but it can also serve as a foundation for future improvements. Modifications can be easily made to the SSLOF table without affecting the original data presented in the primary source tables of the database.

Enclosure   Refinements to the EPA Inventory Database for Stationary Combustion Turbines, version 4 (CTrefine.mdb)

Appendix A
Primary Source Tables in Version 4 of the EPA Inventory Database for
Combustion Turbines

Data Tables:

DATA: APCD - Turbine
DATA: APCD Efficiency - Turbine
DATA: Emissions - Turbine
DATA: Fuel - Turbine
DATA: General Facility - Turbine
DATA: Inventory - Turbine
DATA: Mailing/Owner Address - Turbine
DATA: Non-Fossil/Waste Burned - Turbine
DATA: Permit Information - Turbine
DATA: SIC - Turbine
DATA: Survey Recipients
DATA: T&E Information - Turbine

Lookup Tables:

LOOKUP: Burner Type Codes
LOOKUP: Control Device Codes
LOOKUP: Control Equip Efficiency Method Codes
LOOKUP: Emissions Calculation Method Codes
LOOKUP: Fuel Type Codes
LOOKUP: Governmental Facility Codes
LOOKUP: Operating Status Codes
LOOKUP: Pollutant Codes
LOOKUP: SCC Codes
LOOKUP: SIC Codes
LOOKUP: State Codes
LOOKUP: Unit Codes

Appendix B
Source of Database Fields Extracted from version 4 Primary Source Tables

Field	ICCR Inventory Database version 4 Primary Source Table
ICCR Facility ID	DATA: Fuel - Turbine
Combustor ID	DATA: Fuel - Turbine
Segment No.	DATA: Fuel - Turbine
Combustor Description	DATA: Inventory - Turbines
Segment Description	DATA: Fuel - Turbine
SCC Code	DATA: Fuel - Turbine
Hours of Operation	DATA: Inventory - Turbines
SIC	DATA: SIC - Turbine

Appendix C
Database Fields Created for SSLOF

Table 1. Fields Created and Accompanying Source Codes

Field	Definition
Fuel Type	Type of fuel fired by the turbine.
Fuel Type Source	Source of fuel type; prioritization of source fields: F then C then S then SCC.
Num	Number of turbines; assumed to be 1 unless otherwise indicated.
Num source	Source of information on number of turbines; from sources C and S.
Capacity	Turbine capacity.
Cap Units	Units corresponding to given capacity.
Cap Source	Source of capacity; prioritization of source fields: cap then C then S.
Cap MW	Turbine capacity in megawatts (MW), calculated using conversion factors when capacity not given in MW.
Cap MW Comments	Comments field for the capacity conversion; if the calculation from units other than MW yielded a nonsensical value, it is indicated in this field.
Make	Turbine make.
Model	Turbine model.
Make source	Source of turbine make and model information; from sources C, M, and S.
Model source	
Other info	Other information about the turbine extracted from descriptive fields.
Other info source	Source of other information; from sources C, S, and F

Table 2. Source Codes

Source Code	Source Code Reference Table and Field
F	**"Fuel Type" field in "DATA: Fuel - Turbine"**
C	**Keyword found in "Combustor Description" field in "DATA: Inventory - Turbines"**
S	**Keyword found in "Segment Description" field in "DATA: Fuel - Turbine"**
SCC	**"SCC" field in "DATA: Fuel - Turbine"**
M	**"Model #" field in "DATA: Inventory - Turbines"**
cap	**"Capacity" field in "DATA: Inventory - Turbines"**

**Examples of Key Words and Letter Combinations Used to Extract Information from Selected
Fields within Primary Source Tables in the EPA Inventory Database**

FUEL TYPE

DISTILLATE OIL (DIESEL): Like "*dISTILLATE*" Or Like "*DISTILL*" Or Like "*DIST*" Or
Like "*OIL*" Or Like "*df*" Or Like "*DIES*" Or Like "*DEIS*" Or Like "*dsl*" Or Like "*#2 fuel
oil*" Or Like "*#2fueloil*" Or Like "*#2fuel oil*" Or Like "*#2 oil*" Or Like "*#2oil*" Or Like "*no.
2 oil*" Or Like "*no.2 oil*" Or Like "*no.2oil*" Or Like "*no 2 oil*" Or Like "*no2oil*" Or Like
"*no2 oil*" Or Like "*no. 2 fuel oil*" Or Like "*no.2 fuel oil*" Or Like "*no.2fueloil*" Or Like "*no 2
fuel oil*" Like "*no2fueloil Like "*no2 fueloil*" Or Like "*die*" Or Like "*fuel oil no. 2*" Or Like
"*no2 fuel oil*"

GASOLINE: Like "*Gasoline*" or like "gsln"

KEROSENE/NAPHTA (JET FUEL): Like "*KERO*" Or Like "*FUEL*" Or Like "*NAPHT*"
Or Like "*JET FUEL*"

LANDFILL GAS: Like "*NON-FOSSIL*" Or Like "*NON FOSSIL*" Or Like "*WASTE*" Or
Like "*LANDFILL GAS*" or Like "*Landfill*"or like "*LFG*"

NATURAL GAS: Like "*nAT*" Or Like "*nATL GAS*" Or Like "* ng *" Or Like "*nATURAL
GAS*" Or Like "* nAt*" Or Like "*nATL GAS*" Or Like "*natural*" Or Like "ng *" AND Not Like
"*ing*" And Not Like "*COLNG*" And Not Like "*FLANGES*" And Not Like "*COOLNG*" And
Not Like "*WNG*" And Not Like "*CNG*" And Not Like "*LNG*"

PROCESS GAS: Like "*process gas*" or like "proc*" or like "*prc*"

NON-TURBINE UNITS

Like "*flar*" OR Like "*flr*" OR Like "*heat*" Or Like "*htr*" Or Like "*hetr*" OR Like "*boiler*"
Or Like "*gen*" OR Like "*generator*" OR Like "*forklift*" OR Like "*piston*" OR Like "*recip*"
OR Like "*turbo*" OR Like "*trbo*" OR Like "*blr*" Or Like "*boiler*" Or Like "*boil*" Or Like
"*biol*" or Like "*rich*" or Like "*lean*"

Appendix E
Examples of Information Extracted from the Combustor Description Field in the Primary
Source Table "DATA: Inventory - Turbine" in the EPA Inventory Database

ICCR Facility ID	Combustor ID	Segment No.	Combustor Description	Information extracted
120112094	001	01	LANDFILL-GAS FIRED TURBINE GENERATOR #1	Fuel type was determined to be landfill gas. The fuel type provided in the SCC Code for this unit was Natural Gas.
160550045	010	01	NAT GAS TURBINE	Fuel type was determined to be natural gas. The fuel type provided in the SCC Code for this unit was Process Gas - Unspecified.
220830012	007	XXX1	DELHI 9100HP GE FRAME 3 T	Make: General Electric Model: Frame 3 Capacity 9,100 HP
484810020	010	01	11,350HP GEN.ELECTR. MODELM3122R	Make: General Electric Model: M3122R Capacity: 11,350 HP
490410002	007	01	BACK HOE	Determination made that unit is not a turbine; not included in SSLOF.
497779179	014	01	BULLDOZERS (TRACK TYPE)	Determination made that unit is not a turbine; not included in SSLOF.
060730015	9	XXX1	8 PORTABLE CRANE	Determination made that unit is not a turbine; not included in SSLOF.
421014903	023	01	SHUT DOWN	Determination made that unit is no longer in operation; not included in SSLOF.

490030001	451	01	PORTABLE AIR COMPRESSOR	Determination made that unit is not a turbine; not included in SSLOF.
ICCR Facility ID	Combustor ID	Segment No.	Combustor Description	Information extracted
121130005	014	XXX1	FOUR GAS TURBINES/JAY CENTRAL SALTWATER DISPOSAL FACILITY	Number of units: 4 (Otherwise would have defaulted to 1)
180970071	018	01	12 TURBINE ENGINES	Number of units: 12 (Otherwise would have defaulted to 1)
270170011	001	01	2 IDENTICAL TURBINES	Number of units: 2 (Otherwise would have defaulted to 1)